The IO Range: Tackling Electronic Warfare

By Thomas W. Curby-Lucier

Editorial Abstract: The author examines the complex architecture and methodologies required to provide distributed DOD Electronic Warfare testing, training, and exercise environments. He outlines planning and coordination actions necessary for successful IO Range operations, using a notional joint scenario. Finally, Mr. Curby-Lucier recommends enhancements to best implement future DOD IO Roadmap guidance.

"DOD requires an integrated test range to increase confidence and better assure predictable outcomes. The test range should support exercises, testing, and development of CNA, EW, and other IO capabilities." -- Department of Defense, Information Operations Roadmap, 30 Oct 2003

Introduction

The IO Range, as discussed in the Fall 2006 issue of *IO Sphere*, completed its first round of demonstration events, and is on the way in bringing a realistic IO test, training, and exercise environment to the warfighter. The IO Range provides representative combat targets, systems, and situations to develop IO capabilities. This environment supports realistic Service, component, and combatant commander-sponsored training and exercises. At full operational capability (FOC), the IO Range will also provide a flexible, seamless environment that enables commanders to achieve the same level of confidence and expertise in employing IO capabilities that they have with kinetic weapons. It is intended to facilitate integration of kinetic and non-kinetic capability to demonstrate effects based capabilities and operations.

Presently, the IO Range is a closed-loop network that connects geographically separated sites to support a distributed testing, training, and exercise environment for Computer Network Attack (CNA) capabilities. The current architecture allows it to support multiple simultaneous events and, within each event, networks of different classification levels. As of Initial Capability (IC) in July 2006, the sites require either a permanent or deployable service delivery point to access the IO Range. Figure 1 illustrates a site-end Service Delivery Point, and how its traffic is encrypted prior to entering the Defense Research and Engineering Network (DREN) to reach other IO Range sites. This architecture is very well suited for the current CNA capabilities, and is constantly reviewed for evolutionary changes, in order to fully integrate other IO capabilities, including Electronic Warfare.

Background

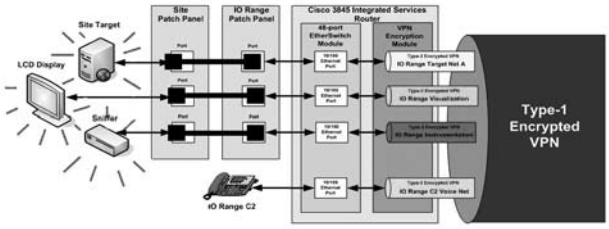

Figure 1. Service Delivery Point for the IO Range.

US Joint Forces Command (USJFCOM) recently completed a 6-month "quick look" across major EW ranges to determine how best to integrate existing electronic warfare range capabilities into the larger IO Range. This effort sought to build on existing capabilities—currently limited to CNA—through the addition of full spectrum EW. The current IO Range architecture, ideal for CNA applications, is under thorough review to ensure that the "aperture is open" for other IO elements. Achieving EW integration will create a test environment for pre-deployment spin-up of EW/CNA capabilities, and move the IO Range closer to achieving the support infrastructures for full-spectrum IO. Further, these efforts will allow US forces to assess advanced EW capabilities, train with combinations of new EW and CNA technologies, and improve tactics, techniques, and procedures (TTP) for employment against sophisticated and emerging threats. This quick look effort also provided a recommended list of sites for EW integration, based on criteria which match COCOM and Service collected requirements (see Figure 2).

For the purposes of this effort, EW integration will add traditional radio frequency (RF)-spectrum operations, non-traditional (i.e., Wireless Telephony Networks), and the ability to explore the use of Directed Energy (DE), including High Power Microwave (HPM) programs. The goal is to focus on the most promising technologies and associated efforts that can meet the pressing needs of commanders and forces engaged in operational environments. EW integration will center on several key areas: use of multiple independent levels of security (MILS) will allow multiple sites concurrent and/or phased execution of range events; visualization of combined EW/CNA events to demonstrate effectiveness of operational and tactical processes; and a

Factors			
EW Capability	Electromagnetic Spectrum Mgmt	Used for EW Experimentation	Secure Chambers (e.g., Anechoic)
EW/CNA Capability	White World EW (Commercial)	Environmental Variables	SCIF
EW Data Collection & Dissemination	Collaborative Tools	Scalability	SAPF
Man in the Loop (Live/Virtual)	HPM Capability	Temporary Secure Working Area (TSWA)	Collateral Spaces
EW OPFOR/Red Team	HEL Capability	Active CMS Account	IOR SDP Available
EW Visualization	Used for EW Test	Collateral Connectivity	DREN Available
EW Instrumentation	Used for EW Training	SCI Connectivity	No OPSEC or Security Concern
Modeling and Simulation	Used for EW Exercise	Other Secure Connectivity	

Figure 2. Requirements Based Criteria for site assessment.

more robust EW environment through an interconnected network of emitters and instrumentation from multiple ranges, platforms (e.g., airborne, mobile) not associated with ranges, and associated visualization tools.

As a mature warfighting discipline, EW has well-developed communities of interest ranging from weapons development to electronic combat ranges. EW has been a central element of tactical and operational level exercises, and has been used extensively in a live-virtual-constructive (LVC) environment. The EW implementation quick-look study sought to expand on this capability by moving closer to the vision outlined in the October 2003 DOD *IO Roadmap*—which directs a combined IO effects capability. This will begin incrementally with the addition of EW, and the resultant changes will provide opportunities for EW/CNA integrated events. To leverage this knowledge and expertise, EW integration efforts seek to identify centers of excellence throughout the DOD and match those capabilities to the most pressing war fighters' needs. This process of aligning critical EW requirements with range capabilities will result in a list of candidate sites to serve as a baseline in forming the initial cadre of EW-capable sites, comprising the next IO Range integration phase. Since many EW-capable sites are the same ones providing CNA capability from Phase 1, integrators are placing maximum effort on leveraging existing Service Delivery Points (SDPs). These provide connectivity to the IO Range backbone, as the command and control structure for combined EW/CNA capability expansion.

EW Integration: What Does It Mean?

Integration of EW capability into the IO Range is based on several key concepts:

• A common federation of independent ranges that cross-leverage each other's EW capabilities

• The ability to integrate fixed sites, mobile platforms, and transient targets

• Execution of combined-effects operations, using full spectrum EW against targets. Impacted targets would include traditional (i.e., RF), irregular (i.e., wireless), catastrophic (i.e., electromagnetic pulse [EMP]), and disruptive (i.e., directed energy [DE])

• Visualization of those effects in a MILS environment which allows interaction of EW Range events simultaneously at the proper levels of security

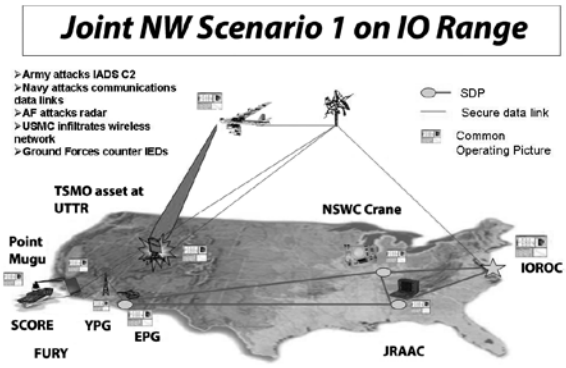

Figure 3. Notional Joint Network Warfare Scenario.

Electronics Technicians help prepare EW systems for a day on the Range. (US Navy)

Cross-linking and sharing of EW capabilities are highly desirable attributes that maximize use of limited/high demand assets. This allows the future Range architecture to link sites, providing the right EW capabilities and targets necessary to prosecute combined EW/CNA operations and effects. This gives IO Range users access to a one-of-a kind capability, and/or with difficult to obtain perishable targets.

In addition to a secure and networked architecture, the EW integration process is the first step in achieving and providing combined-effects IO events. By linking multiple ranges, platforms and targets with different EW and CNA capabilities, IO Range users can test, train, and develop technology and operational art capabilities for the warfighter. Secondly, combined EW/CNA effects can be phased in over time, with additional classification levels, to more accurately reflect an electronic environment as part of a larger campaign plan or tactical level engagement. Finally, the EW integration concept provides opportunities for improved visualization of both EW and combined EW/CNA events for event controllers and test managers. This visualization improves operational execution, enhances situational awareness as events transpire, and provides ground truth for key individuals or organizations such as the exercise/event White Cell.

Integrating EW into the existing CNA environment of the IO Range will enable—through virtual simulations, high fidelity emulations, and actual threat systems—the following activities:

1. Examination of the potential synergies of EW-enabled wireless CNA and CNE. The growing trend towards wireless networks, in both civil and military applications, increases the importance of leveraging existing or developing new EW capabilities to exploit these networks.

2. Testing and training with system-of-systems EW capabilities for US forces. For example, to attack an Integrated Air Defense System (IADS), US Forces could employ a mix of low-observable, stand-off jamming, escort jamming, stand-in jamming, and self-protection capabilities against the tracking, targeting, and engagement radar systems, as well as either EW-enabled or traditional CNA against the radar's command and control network.

An integrated EW and CNA range could fully test and train with these capabilities.

3. Testing and training against an adversary's system-of-systems EW capabilities. For example, a modern IADS consists of a mix of tracking and targeting radar systems plus a layered system of man-portable and vehicle mounted surface-to-air missile (SAM) systems. A few of the more capable ranges might be able to support a subset of these systems, but by pooling the resources and capabilities of multiple ranges, it is possible to create a more realistic representation of system-of-system threats.

a. In addition to the systems, there will be opportunities for US Forces to train against opposing Red forces (OPFOR), which will improve our ability to hone Blue Tactics, Techniques, and Procedures (TTP) against Red forces.

We can best illustrate the EW integration concept through use of a notional scenario (Figure 3), which employs combined EW/CNA capabilities provided by the IO Range. Here the Range approaches the ability to permit full spectrum Network Warfare. In this scenario, mission requirements dictate the defeat of an enemy IADS as well as Command, Control, Communications, Computers, and Intelligence (C4I), all as part of a conventional operation. The following sections describe the logical steps used to conduct a combined-effects event on the IO Range, using a Plan, Brief/Coordinate, Execute, and Debrief/Assessment (PBED) process.

Plan

The first step is to identify existing capabilities necessary to achieve desired effects. IO Range event planners work with the customer to identify the proper capabilities which exist at various sites which are part of the IO Range. In this hypothetical scenario, the team identifies sites that can support the mission objectives, and are available for such an event, as follows:

• TSMO provides an actual threat radar

• UTTR provides range and air space for TSMO asset

• Air Force B-52 provides Electronic Attack against TSMO asset

• SCORE provides IADS threat emulations and a training venue for Third Fleet

• FURY provides Red communications for countering by Third Fleet

• Point Mugu provides EA-6B Prowler capability via one of their labs

• NSWC, Crane provides EA-6B Prowler fidelity against IADS threats

• JRAAC-MSIC provides IADS modeling for all players

• YPG provides a wireless communications network

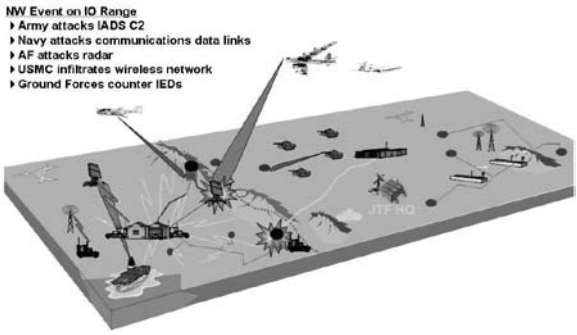

Figure 4. Notional Joint Network Warfare Scenario superimposed on the IO Range.

• Marine Corps tactical units conduct exploitation of wireless network at YPG

• Information Operations Range Operations Center (IOROC) ensures event synchronization, distribution of information, and a common operating picture (COP).

The next step in the planning process is to identify visualization and instrumentation requirements. Range events require both, to capture the right information in the right format, to ensure relevance to the event requirements. In this scenario, the mission may require a Joint Task Force (JTF) commander to visualize the combined EW/CNA effects on a battlefield, in order to assess operational effectiveness and identify and address shortfalls that may arise. Test community requirements may dictate parametric data capture/storage for post-event analysis, while training audiences will need to review training events. In this scenario, each site captures EW effects and transmits these back to the IOROC for synchronization and consolidation. These effects could be displayed on a variety of visualization tools, such as Google Earth, Starship, and/or Falcon View.

Brief/Coordinate

Once the sites have been identified, Range members and customers will brief the event plan, and ensure schedule coordination. For this scenario, availability of EW ranges and platforms possessing the appropriate capabilities would be verified in order to support the specific needs of this event. Additionally, the players would review security considerations such as Special Access Required/Special Access Program (SAR/SAP) requirements. The Range's MILS structure could be used to organize and compartment all training and/or test events required to successfully replicate the appropriate C4I, IADS—and the capabilities required to counter them. This is a unique, highly desirable IO Range attribute, as it brings together different sites, platforms, and targets at varying levels of security. This combination has traditionally been very difficult to accomplish, thus even early integration efforts provide a long sought after solution.

Execute

Execution of this scenario involves numerous IO Range nodes, as depicted in Figure 4. The Army or ground component would provide live and/or virtual forces to attack the IADS command and control structure, and provide sites and assets for proper scenario execution. The Navy or maritime component would counter communications data links at SCORE and FURY, and would also provide electronic attack assets in a lab environment. The Air Force or air component would provide an

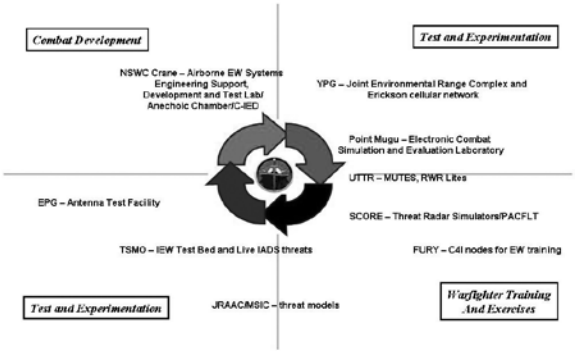

Figure 5. IO Range facilitating the merge of various capabilities from EW communities of interest, including combat developers, Joint Testing and Experimentation, and Warfighters.

electronic attack asset and an open air range to conduct strikes. The Marine Corps would infiltrate the wireless network at YPG while countering IEDs in the process of getting to their target. The execution phase also highlights potential modifications to the IO Range architecture, which could further enhance EW integration. This potential new architecture builds on the IO Range IC architecture of SDPs and adds secure tactical data links (TDL) such as Link 16, secure wireless, and other secure links to fully integrate fixed sites, mobile platforms, and transient targets. Range participants would monitor execution phase results via a common operating picture, offering players a coordinated, real time collaborative environment.

Debrief/Assess

In conducting combined-effects EW/CNA operations, it is imperative we properly assess capabilities employed against the threat network. By having proper visualization and instrumentation, Range participants can properly assess the results of a range event to determine the effectiveness of combined IO capabilities. This is critically important to identify the effectiveness of EW and CNA, and to demonstrate the synergy of employing combined effects in an IO Range environment. Such visualization needs to be shared among all players in the collaborative environment, in order to increase confidence in non-kinetic effects as well as aid decision makers. For this scenario, we could demonstrate the synergistic effects of using jamming platforms against emitters with CNA effects. As a result, warfighters may attempt new tactics, techniques, and procedures—such as a point defense against terminal SAMs and against Improvised Explosive Devices (IEDs) —or operational-level effects such as disruption and/or denial of IADS C2 or other C4I. Notably, this hypothetical scenario brings together various EW communities of interest, including combat developers, joint testing and experimentation, and warfighters, as depicted in Figure 5.

Additionally, every scenario includes post mission and/or test analysis. This provides the training audience and/or test managers a clear picture of what transpired and why. More importantly, it provides the venue for follow-on corrective actions as well as validation of the EW/CNA capabilities employed. Bringing this Electronic Warfare capability to the IO Range—and utilizing this event process—offer traditional kinetic range benefits for the non-kinetic IO arena.

Way Ahead

Although this article used a single notional scenario to articulate EW integration on the IO Range, customers can define numerous other requirements driven scenarios. Events that include the Air Force Distributed Mission Operations Center (DMOC), and other intelligence production organizations such as the National Air and Space Intelligence Center (NASIC) and National Ground Intelligence Center (NGIC), can truly enhance the ability to bring realistic EW events into a live, virtual, and constructive environment. Given the appropriate amount of resources, the IO Range can move one step closer to its vision:

Create an integrated infrastructure environment which enables Combatant Commanders and Component Commanders to achieve the same level of confidence and expertise in employing information operations capabilities as they have with kinetic weapons.

In a sense, the IO Range ability to facilitate EW events in support of tests, training, exercise, and experimentation is limited only by imagination. As the IO Range tackles EW for future operations, it takes one more step towards full-spectrum IO support to the warfighter.